

VERY LONG WAVELENGTH InGaAs/GaAs QUANTUM WELL INFRARED PHOTODETECTOR

S. D. Gunapala

Center for Space Microelectronics Technology, Jet Propulsion Laboratory, California
Institute of Technology, Pasadena, CA 91109, USA

ABSTRACT

There has been much interest in very long-wavelength GaAs/Al_xGa_{1-x}As quantum well infrared photodetectors (QWIPs) and associated intersubband absorption due to their mature technology and the possibility of producing high performance large area two-dimensional imaging arrays. Due to the possibility of large 2-D arrays and additional advantages such as low 1/f noise, low power dissipation, high differential resistance and high radiation hardness these QWIPs should be suitable for very long-wavelength applications such as global temperature monitoring (e.g. earth observing satellites) and long-wavelength astronomy. Since the quality of the barriers is extremely important for optimum QWIP performance, and the fact that binary barrier QWIPs have superior carrier transport properties¹, it is interesting to study the GaAs/In_xGa_{1-x}As materials system for very long-wavelength QWIPs.

We will discuss the *first high-detectivity* ($D^* = 1.8 \times 10^{10} \text{ cm}^2/\text{Hz/W}$) GaAs/In_xGa_{1-x}As QWIP in the very long-wavelength infrared region at $\lambda_p = 16.8 \mu\text{m}$ (operating at a temperature of $T = 40 \text{ K}$). The large responsivity and detectivity D^* values are superior to those achieved with the usual lattice matched GaAs/Al_xGa_{1-x}As materials system. The high optical gains and the small carrier capture probabilities demonstrate the excellent carrier transport of the GaAs barriers and the potential of this heterobarrier system for very long-wavelength ($\lambda > 14 \mu\text{m}$) QWIPs. By comparing the theoretically calculated peak wavelengths and spectral widths we have determined the band offsets ΔE_c and ΔE_v for the non-lattice matched GaAs/In_xGa_{1-x}As heterobarrier.

1. S. D. Gunapala, B. F. Levine, D. Ritter, R. A. Harem, and M. B. Panish, Appl. Phys. Lett. 58,2024 (1991).